



United States Department
of Agriculture
Agricultural Research
Service



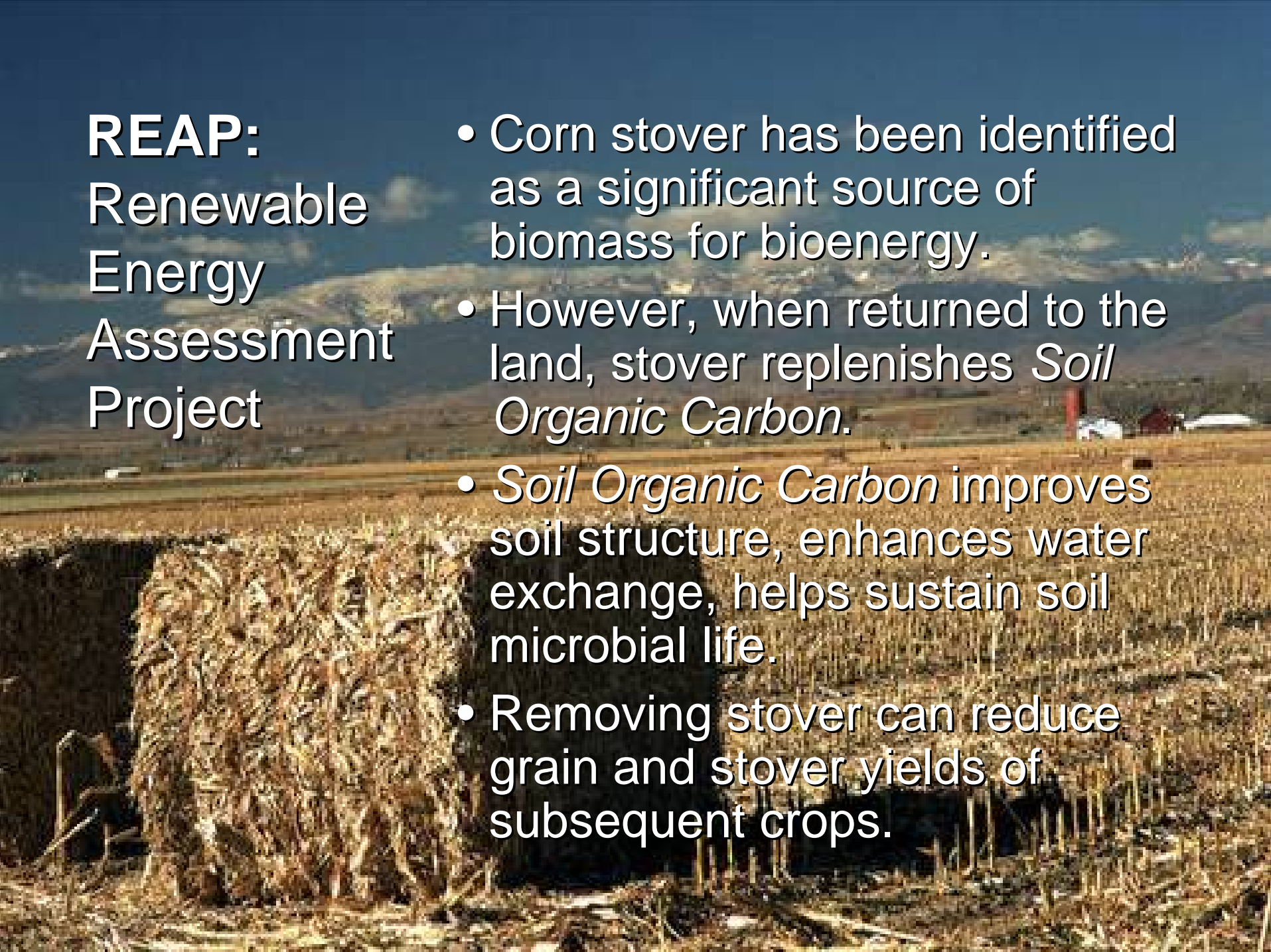
REAP: Renewable Energy Assessment Project

Ghassem R. Asrar

Deputy Administrator

Natural Resources and Sustainable
Agricultural Systems

National Academies of Science
First Federal Sustainability Research and Development Forum
Biofuels - State of the Art Examples of Sustainable Research and Development
October 17, 2007



REAP:
Renewable
Energy
Assessment
Project

- Corn stover has been identified as a significant source of biomass for bioenergy.
- However, when returned to the land, stover replenishes *Soil Organic Carbon*.
- *Soil Organic Carbon* improves soil structure, enhances water exchange, helps sustain soil microbial life.
- Removing stover can reduce grain and stover yields of subsequent crops.

REAP: Renewable Energy Assessment Project

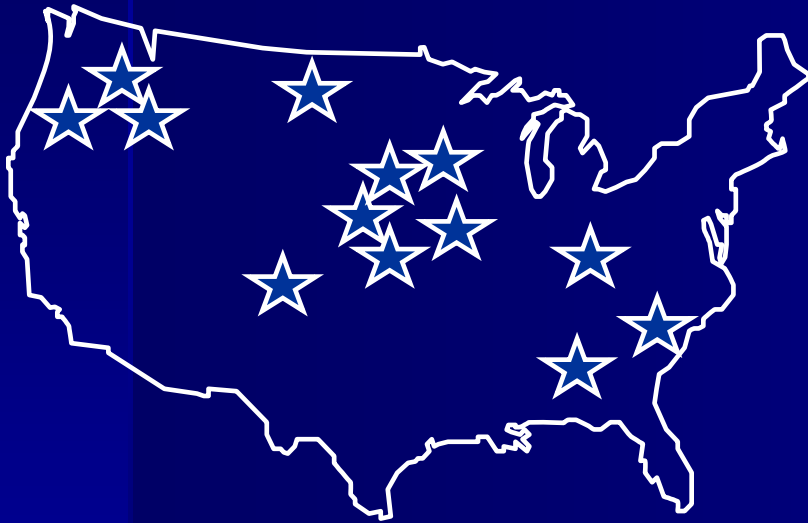
Sustainability Challenge

How to harvest corn stover without depleting *Soil Organic Carbon* and still contribute significant amounts of biomass for biofuels production



REAP: Renewable Energy Assessment Project

ARS Research Infrastructure

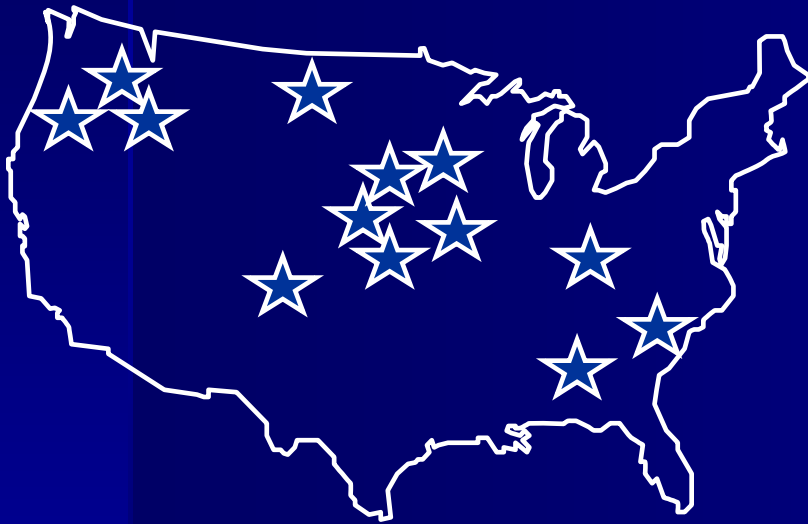


REAP Team Locations

- Nation-wide network of coordinated research teams.
- Historic watersheds, long-term experiments, and databases.
- Interdisciplinary approach including bio-physical sciences, modeling, and economics.
- Excellent collaborations with universities, industry, and other Agencies.

REAP: Renewable Energy Assessment Project

Infrastructure Applied for Outcomes

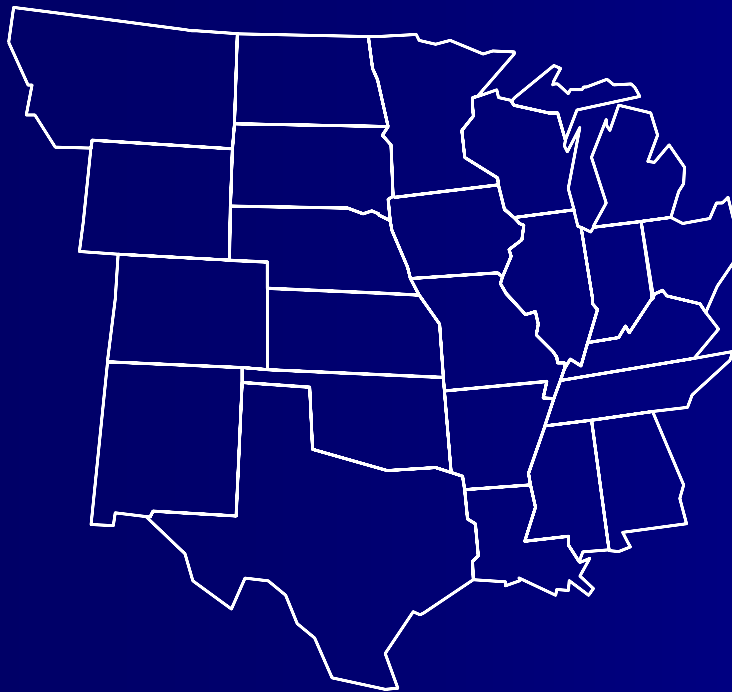


REAP Team Locations

- Documentation of management system effects.
- Algorithm-based guideline to sustainable harvest.
- Place-based decision support tools:
 - Residue harvest estimator.
 - Quantify stover economic and ecosystem service benefits.

REAP: Renewable Energy Assessment Project

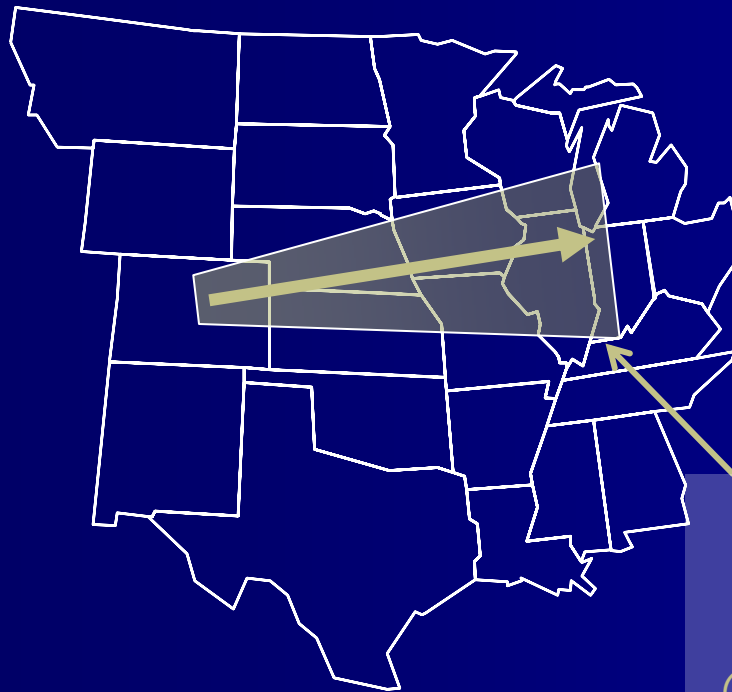
Natural environment affects
SOC replacement requirements:



- No one replacement recommendation is possible.
- Moisture gradient.
- Temperature gradient.

REAP: Renewable Energy Assessment Project

Natural environment affects
SOC replacement requirements:



- No one replacement recommendation is possible.
- Moisture gradient.
- Temperature gradient.

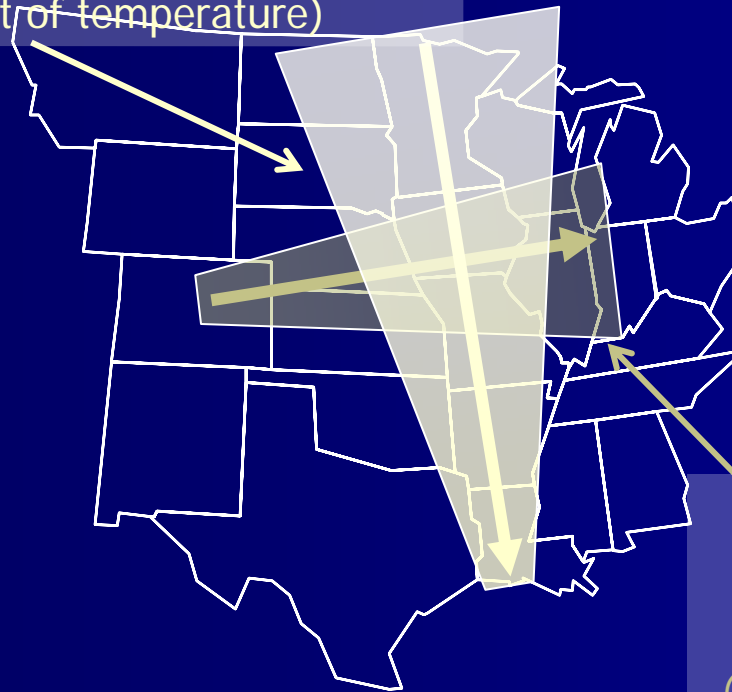
Effective moisture increases
from west-to-east
SOC Increases
(Result of Net Primary Production)

REAP: Renewable Energy Assessment Project

Average temperature increases
from north-to-south
SOC Decreases
(Result of temperature)

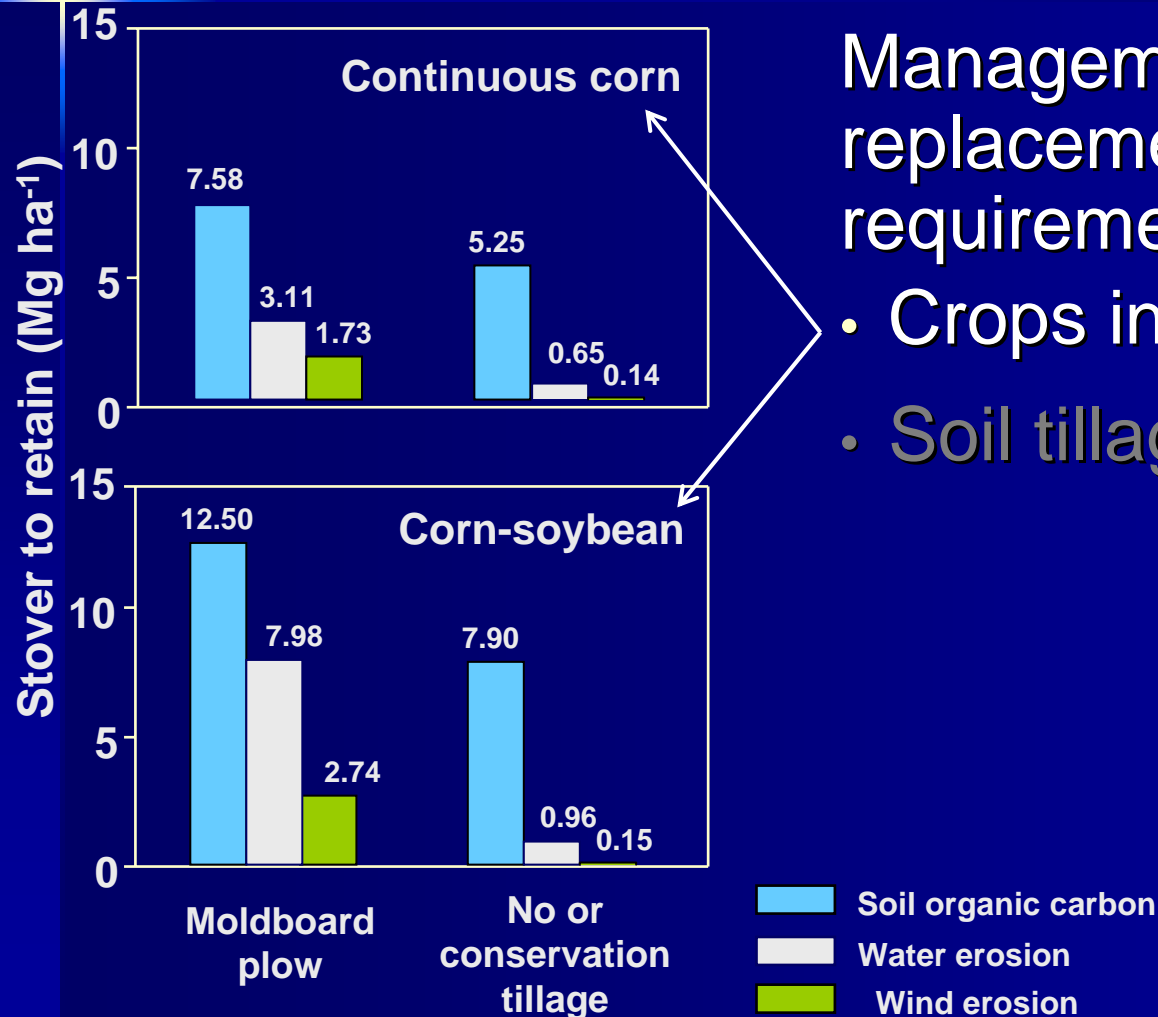
Natural environment affects SOC replacement requirements:

- No one replacement recommendation is possible.
- Moisture gradient.
- Temperature gradient.



Effective moisture increases
from west-to-east
SOC Increases
(Result of Net Primary Production)

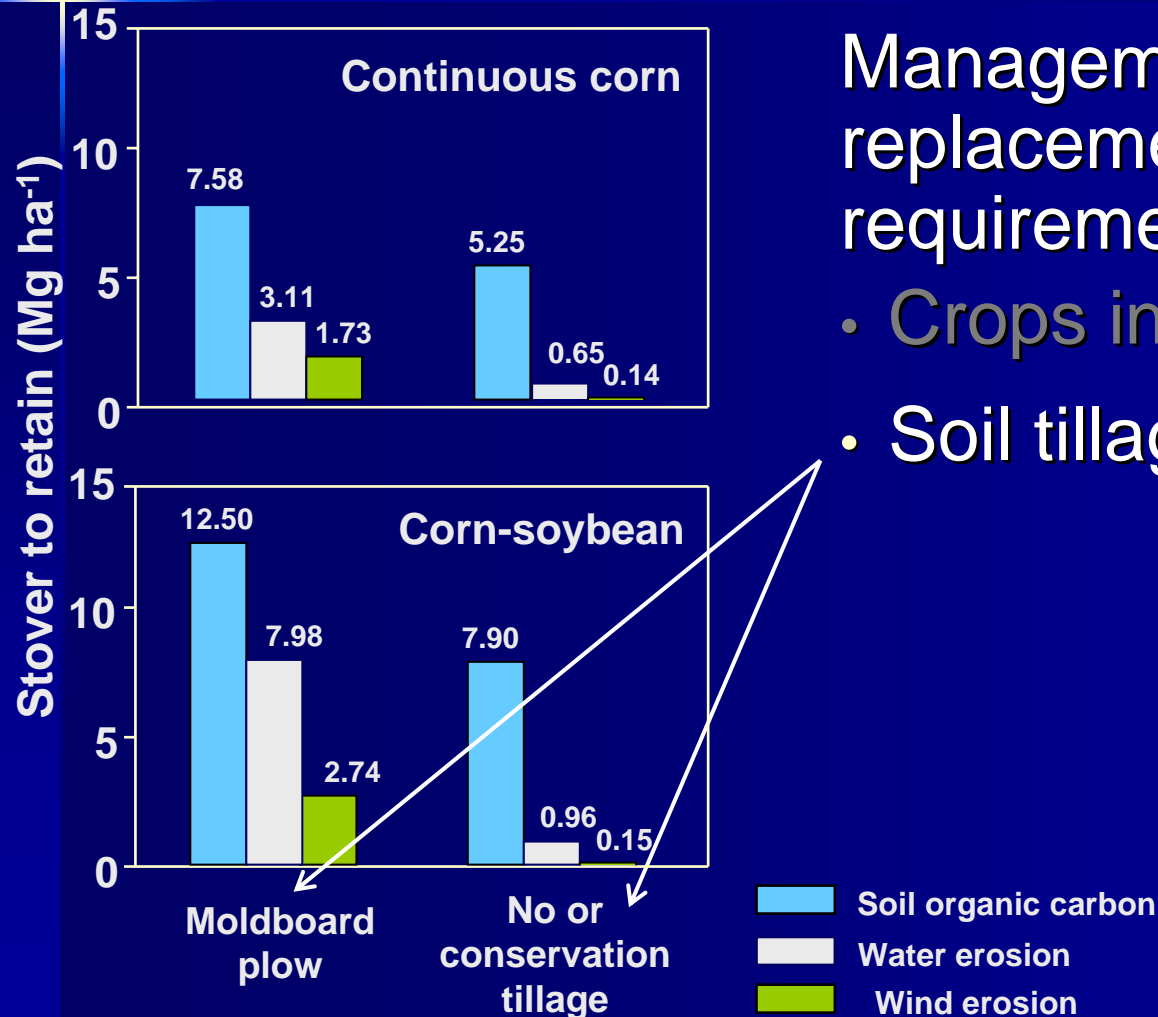
REAP: Renewable Energy Assessment Project



Management affects SOC replacement requirements:

- Crops in rotation
- Soil tillage preparation

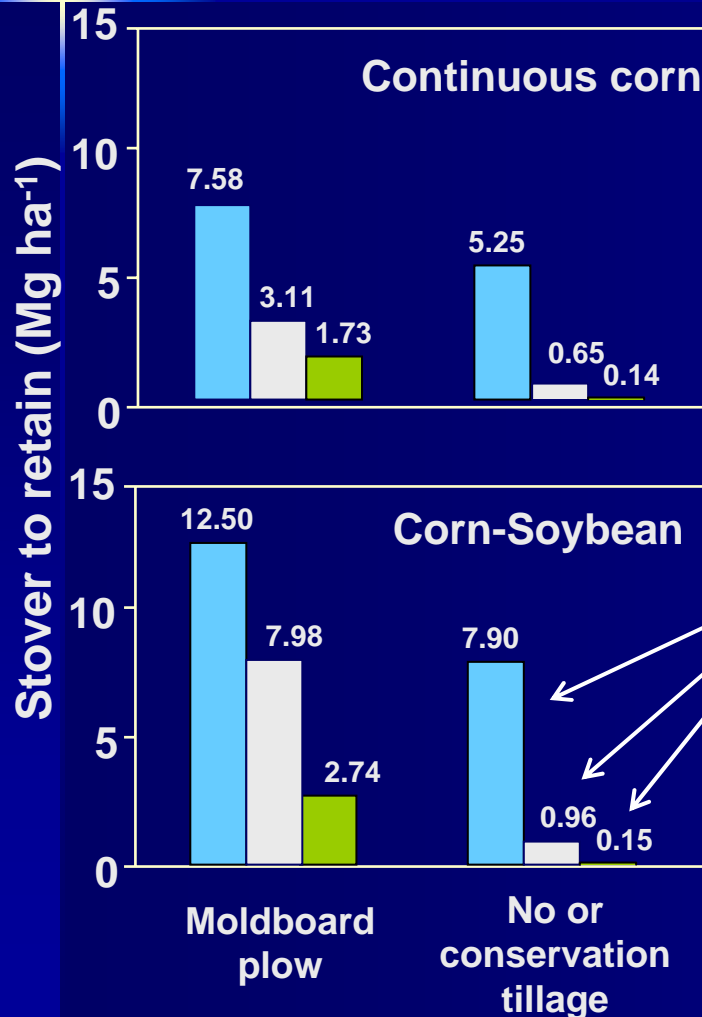
REAP: Renewable Energy Assessment Project



Management affects SOC replacement requirements:

- Crops in rotation
- Soil tillage preparation

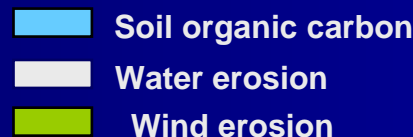
REAP: Renewable Energy Assessment Project



Management affects SOC replacement requirements:

- Crops in rotation
- Soil tillage preparation

More stover is needed to maintain *Soil Organic Carbon* than to prevent water and wind erosion.



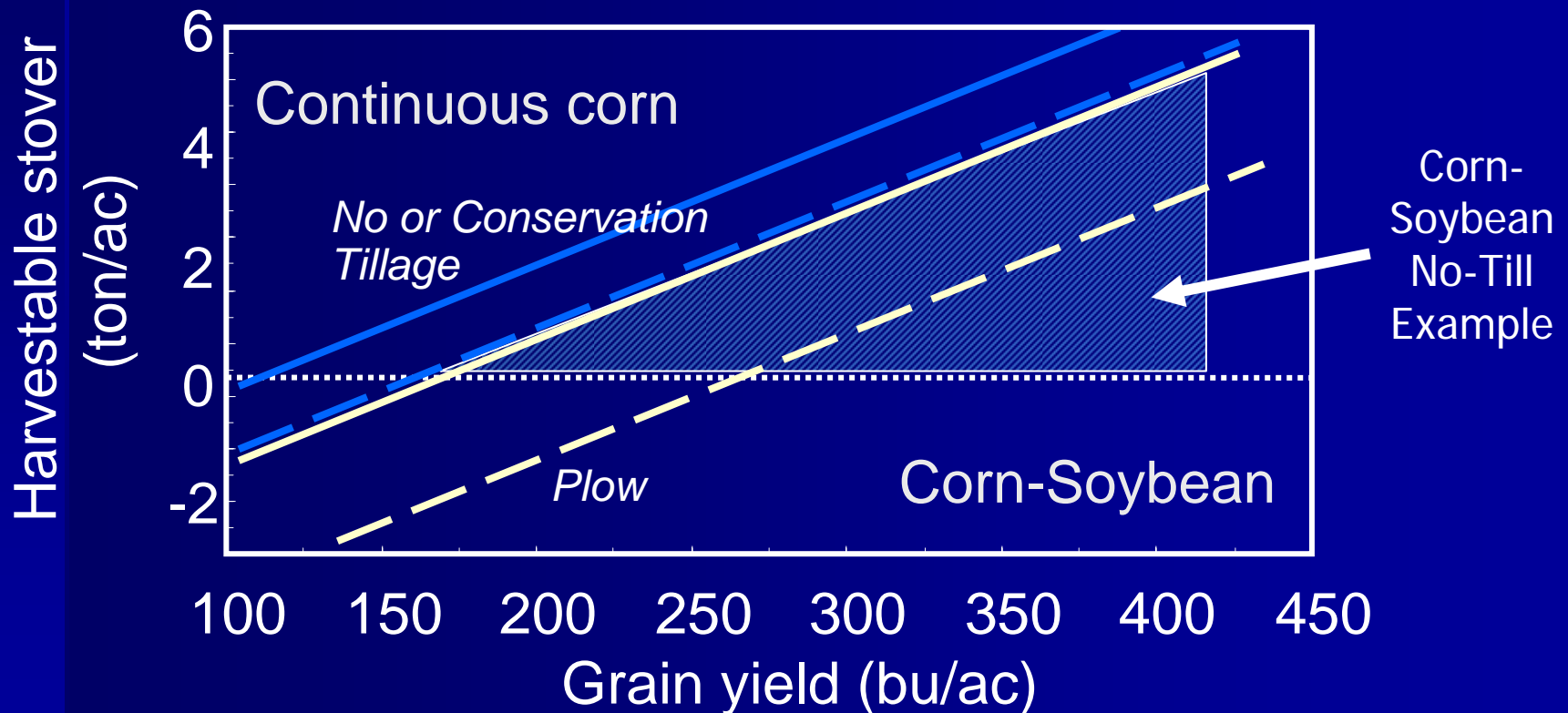
REAP: Renewable Energy Assessment Project

Corn stover removed from fields also has a nutrient replacement cost.

Element	Amount in stover	Value
	Lbs/ton	\$/ton
Nitrogen	16.0	8.00
Phosphorus	1.6	1.52
Potassium	13.5	2.29
Total cost		\$11.81

REAP: Renewable Energy Assessment Project

Harvestable corn stover amount by different soil management practices and grain production levels



Challenges and New Opportunities from Agriculture

- Continued traditional outputs for an increasing world population:
 - Food, feed, and fiber
- Ecosystem services:
 - Control erosion & nutrient loss
 - Sequester carbon
 - Wildlife habitat
 - Water quality & quantity
- Replenish SOC & plant nutrients.
- Feedstocks for biofuels.



REAP: Renewable Energy Assessment Project

Wally Wilhelm, ARS-Lincoln, NE

Doug Karlen, ARS-Ames, IA

Idaho National Laboratory

Oak Ridge National Laboratory

National Renewable Energy Laboratory

USDA-NRCS